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Surface Force Response Plan Tool

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SURFACE FORCE RESPONSE PLAN TOOL

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Topic Sponsor: US Fleet Forces Command (USFF)
Research Sponsor Organization (if different): COMNAVSURFOR
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EXECUTIVE SUMMARY

Project Summary
Commander Naval Surface Forces (COMNAVSURFOR) provides appropriately manned, trained, and equipped surface forces to operational commanders to meet presence and operational requirements in accordance with various plans and directives. This research developed a management tool to assimilate all readiness metrics (manning levels, maintenance requirements, training, and ordnance loadouts) to help COMNAVSURFOR staff to understand if future requirements can be met and/or what resource gaps and shortfalls must be addressed. Optimization (integer linear programming) was used to identify the most efficient coverage of presence and operational requirements given resource constraints and to aid in gap identification. Detailed classified results are reported in the Operations Research thesis completed by LT Fields in September 2018. A demonstration to COMNAVSURFOR (VADM Brown) occurred in October 2018.

Keywords: *optimization, integer programming, integer linear programming, navy operational planner, maritime operational planning tool, decision aid, navy mission planner*

Background
Operations Research Department faculty and students at the Naval Postgraduate School have developed an impressive list of optimization models to aid with joint maritime operational planning. This planning requires the assignment of platforms over various time horizons to accomplish missions subject to a multitude of limited resources. For example, the 2016 thesis by LT Molina "Navy operational planner – undersea warfare module" provides an optimization model that plans the best assignment of surface, sub-surface, and air assets to meet undersea warfare requirements. In a related example, the 2017 thesis by LT Newman "An efficient missile loadout planning tool for operational planners" heuristically plans the assignment of missiles on ships in response to anticipated future threats. While similar, neither of these theses (or prior efforts) directly addresses the requirements of COMNAVSURFOR to provide a plan for the best use of available assets with current readiness metrics to respond to a known contingency within a given timeframe. This completed research provides this needed decision support.

Findings and Conclusions
Dr. Robert Dell and LT Eric Fields met with the sponsor at the start of the research effort to understand the maintenance, training, and deployment scheduling cycle as well as the resources and constraints in preparing ships to meet operational requirements. Readiness metrics were reviewed and sources of data identified. Discussions also provided a detailed listing of the sponsor's desire for model prescriptions to aid in scheduling and resource assignments.

Following problem identification, a mathematical formulation (an integer linear program) of objectives, variables, and constraints was written, reviewed, and refined. It was implemented in commercially

available software to test its functionality and results. Real-world data was taken from sources identified by COMNAVSURFOR as input for the integer linear program. The sponsor was briefed on the initial results and invited to critique and make suggestions for improvement. A final model was completed and documented in the classified Operations Research thesis completed by LT Fields in September 2018. A demonstration to COMNAVSURFOR (VADM Brown) occurred in October 2018. LT Fields' thesis provides detailed classified findings.

Recommendations for Further Research

Future works includes programming a heuristic solver in Visual Basic for use in an EXCEL spreadsheet. This would provide COMNAVSURFOR staff access to the benefit of the optimization-based management tool on Navy/Marine Corps Intranet (NMCI) computers.

References

FIELDS, E., Lieutenant, USN, "Optimally Allocating Naval Surface Assets in Times of Crisis (U)", MS in Operations Research, September 2018.

Acronyms

COMNAVSURFOR - Commander, Naval Surface Forces
NMCI - Navy/Marine Corps Intranet (NMCI)